

Other lines of research: ant colonies, robots and reasoning under uncertainty

*Dr Alexander Ressos, TEP
Attorney-at-Law (Switzerland), Solicitor (Hong Kong),
Solicitor (England & Wales)*

IDSIA's work is broader than neural networks. In the 1990s Luca Maria Gambardella, who later directed the institute for many years, and Marco Dorigo developed the "ant colony system", a method of combinatorial optimization inspired by the behaviour of ants, which find short paths between their nest and food sources by laying and following chemical trails. The method was applied to the travelling salesman problem and to vehicle routing. It also led to one of the first spin-off companies of the institute, which offered route optimization to logistics and distribution companies.¹ In 1997 IDSIA was listed among the top ten artificial intelligence laboratories in the world and among the top four in biologically inspired artificial intelligence.² A robotics laboratory followed in 2007, with research on learning robots, swarm robotics and humanoid robots.³ Marco Zaffalon's group works on imprecise probabilities and probabilistic graphical models, that is on methods for reasoning and deciding under uncertainty when the available data do not justify a single probability distribution. Cesare Alippi's group works on learning in non-stationary environments, graph neural networks and intelligent embedded systems.⁴

Several of these research lines have a direct relevance for finance. Reasoning under uncertainty is the subject matter of risk management. The detection of changes in data streams, known in the machine learning literature as concept drift, is the problem that FINMA addresses when it asks supervised institutions to monitor "data drift" in their artificial intelligence applications, as described below.⁵ Optimization methods are used in portfolio construction and in the allocation of collateral. Recurrent and sequence models are used to analyse time series of prices and transactions. The institute has carried out projects with companies in the region. Its researchers have also founded start-ups. The best known is NNAISENSE, which Schmidhuber formed in 2014 to work on commercial applications of artificial intelligence in fields such as finance, heavy industry

and self-driving cars. The company described its aim as building generalpurpose artificial intelligence, although Schmidhuber has more recently said that its focus has shifted from artificial general intelligence to asset management, which brings it close to the subject of this book.⁶

1 Teaching and the ethics of machine learning

IDSIA teaches at both of its parent institutions. It contributes to the Bachelor of Science in Data Science and Artificial Intelligence at SUPSI, to the Master of Science in Engineering at SUPSI and to the Master of Science in Artificial Intelligence at USI.⁷ The institute also participates in the public debate on the ethics of artificial intelligence, with particular attention to the transparency and fairness of machine learning algorithms.⁸ Fairness in this sense means the absence of unjustified discrimination in the outputs of a model, for example in credit decisions, insurance pricing or the selection of job applicants. Transparency means that the model's operation and its results can be understood by those who use it and by those affected by it. Both concepts have since become legal requirements in the European Union's Artificial Intelligence Act and supervisory expectations in FINMA's guidance on artificial intelligence, which this chapter examines in later sections.

For the financial centre, IDSIA represents a resource of a kind that few cities of Lugano's size possess. Its researchers and graduates form a pool of expertise on which banks, insurers, asset managers and technology firms can draw, either by recruiting graduates or by commissioning applied research. The institute's long history also provides a measure of credibility when the canton presents Ticino as a location for artificial intelligence. It would be wrong, however, to infer from the institute's academic success that Lugano has become a commercial centre of artificial intelligence. The large-scale development of artificial intelligence takes place in a few American and Chinese companies and, in Switzerland, mainly in Zurich, where several of the large technology companies have research centres. IDSIA's contribution to the financial centre lies in knowledge, people and applied projects.

Common misconception. It is sometimes said that modern large language models were "invented in Lugano". This overstates the case. The LSTM architecture developed by Hochreiter and Schmidhuber in 1997 and refined at IDSIA was a foundational method of deep learning and dominated speech recognition and machine translation in the mid-2010s. Today's large language models are based on the transformer architecture published by Google researchers in 2017. IDSIA's work belongs to the history of the

methods on which they build, and the institute remains an important centre of research, but the commercial development of large language models has taken place elsewhere.

2 Notes

1. Marco Dorigo and Luca Maria Gambardella, "Ant Colony System: A Cooperative Learning Approach to the Traveling Salesman Problem", IEEE Transactions on Evolutionary Computation 1 (1997), 53–66. ↩
2. Wikipedia, "Dalle Molle Institute for Artificial Intelligence Research" (above) (1997: "listed among the top ten artificial intelligence laboratories, and among the top four in the field of biologically-inspired AI"). ↩
3. Wikipedia, "Dalle Molle Institute" (above). ↩
4. USI, IDSIA unit page, <https://search.usi.ch/it/unita-organizzative/351>, lists among the institute's fields of competence "Graph deep learning", "Apprendimento in ambienti non stazionari" and "Sistemi integrati e ciberfisici". ↩
5. FINMA, Guidance 08/2024 "Governance and risk management when using artificial intelligence" (18 December 2024), section 2.4, <https://www.finma.ch/en/~media/finma/dokumente/dokumentencenter/myfinma/4dokumentation/finma-aufsichtsmittelungen/20241218-finma-aufsichtsmittelung-08-2024.pdf>. ↩
6. Schmidhuber, home page (above) (Chief Scientist of NNAISENSE, "which aims at building the first practical general purpose AI"); Wikipedia, "Jürgen Schmidhuber" (above) ("In 2014, Schmidhuber formed a company, NNAISENSE, to work on commercial applications of artificial intelligence in fields such as finance, heavy industry and self-driving cars"; "as of 2026 he has said that the focus of NNAISENSE has shifted from artificial general intelligence to asset management"), consulted as a last resort. ↩
7. SUPSI, IDSIA, "Istituto" (above). ↩

Other lines of research

8. SUPSI, IDSIA, "Istituto" (above) ("ethical artificial intelligence, with a particular focus on the transparency and fairness of machine learning algorithms"). ↩

For general information only. This article does not constitute legal or tax advice, does not replace advice on an individual case and creates no lawyer-client relationship. It reflects the legal position as of September 2026.

Online version: helveticaregister.com/lugano-other-lines-of-research-ant-colonies-robots-and-reasoning-under-uncertainty